IMPERIAL
Grantham Institute

Exploring stratified turbulent mixing by shear instabilities in coastal waters

Supervisor: Dr Adrien Lefauve **Department of Civil and Environmental Engineering**

Project Overview: Water will likely become the gold of the 21st century, due to its central role to life and the economy and its increasing scarcity under climate change. Estuaries are particularly interesting as they represent key transition and exchange zones between freshwater and marine environments and often host great cities, including London. A key question in estuarine hydrodynamics is: how does turbulence mix freshwater and denser saltwater? This project will focus on the lifecycle, turbulent energy cascade, and mixing of large-scale shear instabilities, the primary structures responsible for mixing in estuaries. Recent field observations prove that mixing does not generally occur by overturning in the 'cores' of the primary 'billows', as previously thought. Instead, we will investigate the hypothesis that mixing occurs along their 'braids' by secondary shear instabilities with potentially different mixing properties. You will perform mathematical analyses of state-of-the-art in-situ data, including multibeam echograms (acoustic backscatter), which provide a high-resolution picture of underwater turbulent mixing. You will then formulate new fluid mechanical models that bridge the challenging spectrum of scales. The goal will be to develop new hypotheses, ideally leading you to design a new fieldwork campaign to gather complementary data. There will be the opportunity to perform fieldwork in the USA in collaboration with the Woods Hole Oceanographic Institution. The ideal outcome would be to distil the new physics of mixing into practical reduced-order models called parameterisations, to ultimately improve the coastal models that are used to address sustainability challenges.

To apply:

Please email lefauve.adrien@gmail.com and include in your application:

- Statement of Purpose
- Your CV

At least two references to be sent directly to Dr Lefauve from the referees.